

degree distinct and forcible, not merely of the objects themselves, but even of the greatly altered intensities of light under which we view them. . . . Thus the imitation of Nature in the picture is at the same time an ennobling of the impression on the senses."

Let me congratulate you on the fact that here, at all events, the importance of physical science in its relation to art is not forgotten. J. NORMAN LOCKYER.

LUMINOUS CLOUDS.

IN an article contributed to NATURE on November 20, 1890 (vol. xliii. p. 59), Herr O. Jesse (of the Royal Observatory of Berlin) gave an account of his observations of luminous clouds. He has recently submitted to the Prussian Royal Academy of Sciences a record of later work; and, as the subject is one of considerable interest, it may be worth while to translate his paper.¹

With regard to the results, already briefly noted, obtained in the summer of 1890, I have now to report more precisely, that with the help of the grant made by the Academy of Sciences we were able, during the period when the phenomenon appeared, to secure a collection of photographs which afford rich material for study.

On this as on previous occasions the clouds were visible only between the end of May and the beginning of August. They appeared for the first time, in 1890, on May 26; for the last time—and then there was only a feeble trace of them—at the beginning of August. The phenomenon, therefore, was seen within nearly four weeks of the summer solstice—before and after it—but chiefly after it.

Since my last report, I have received confirmation of the statement that the time when the phenomenon appears in the southern hemisphere has a corresponding relation to the summer solstice there. Unfortunately, however, more precise facts with regard to place, &c., in the southern hemisphere, are still lacking.

During the period between May 26 and July 24, 1890, we obtained altogether 180 photographs of luminous clouds at Steglitz, Rathenow, and Nauen, and at the Observatory of Urania, Berlin. Of these photographs, 75 are suitable for the determination of height, inasmuch as they were secured at the same time in at least two different places. Thirty of the photographs may be used for the determination of the speed and direction of the movements of the clouds, because their representations of the clouds were taken at proper intervals at one and the same place. The remaining photographs are adapted for investigations relating to the dimensions of the clouds and their structure.

The phenomenon was again less bright than it had been in the preceding year. Only when the atmosphere was exceptionally transparent was there an approach to the former brilliancy. The aggregations of these masses of particles are obviously becoming thinner, as may also be perceived from the more distinct appearance of certain relations of structure, like the ridge and rib formations (wave formations) mentioned in my last report. Formerly these were concealed by superposition and apparent interference of a greater richness of analogous strata; now the characteristic lines of the configurations consisting of these ridge and rib formations present themselves more simply and in greater isolation.

It has now been proved more successfully than before that the ridges or longitudinal strips lie parallel to, while the ribs or cross strips are almost at right angles to, the direction of the movement of the entire cloud. Further, we made on different days several series of measurements

of the distances of the ribs (wave-crests) from one another with the following groups of results:—

Mean value of the distances of	9 wave-crests	Kilom.
"	10	8.3
"	"	9.9
"	10	8.4
Average		8.9

Especially striking, last summer, was the difference between the clearness with which the clouds appeared in the morning hours, and that with which they appeared at the corresponding times before midnight.

With regard to the height of the luminous clouds in the summer of 1890 the measurements, so far as they were definitely calculated, gave the mean value of 82 kilom., agreeing almost exactly with the value of nearly 83 kilom., deduced from my photographs of 1889.

The persistence from year to year—now for the first time shown with sufficient accuracy—of the distance, and therefore of the position of the level surface of the phenomenon, would alone deserve to be recorded as a scientific fact of great importance.

As for the speed and directions of the movements, it was again found that the chief component of the movement was directed from east to west, and amounted to nearly 100 metres in the second, while the speed of the revolution of the zone of the earth above which the clouds were placed is about 240 metres in the second from west to east.

There was also a smaller and variable component in the direction of the meridian. This was directed from north to south at the times at which we have hitherto obtained tolerably secure determinations of movement.

The points of view from which the phenomenon of luminous clouds, on the ground of the observations hitherto made, is to be regarded, are already numerous. There is still, however, a wide field for research in connection with the questions, What are the forces which make the phenomenon appear chiefly in the morning hours? and, What is the nature of those forces which cause the movement of the clouds to be mainly from the north-east, and drive them from the northern to the southern hemisphere and back again? Then the question as to the height of the phenomenon in different latitudes is probably of great importance for the constitution of our atmosphere; and not less interesting is the question relating to the material of which the luminous clouds are composed. Unfortunately the interest taken by the scientific world in this remarkable phenomenon is in general so small that during the short time the phenomenon will probably present itself we can scarcely expect to obtain for these questions answers that shall be to any considerable extent satisfactory.

WILHELM EDUARD WEBER.

THE venerable physicist, Wilhelm Eduard Weber, whose death on June 23 we shortly announced last week, was born at Wittenberg on October 24, 1804, the second of three sons of Michael Weber, Professor of Positive Divinity at Wittenberg. He studied at the University of Halle, where Schweigger was then Professor of Physics; he took his Doctor's degree in 1826, became Privatdocent in the following year, and Professor-Extraordinary of Physics in 1828. In 1831 he was called to Göttingen to succeed Johann Tobias Mayer in the Chair of Physics, and remained there till 1837. Among other results of the death in this year of King William IV., there came about serious changes in the University of Göttingen. Queen Victoria being excluded from the throne of Hanover, by the operation of the Salic law, her uncle, Ernest Augustus, Duke of Cumberland, became King of Hanover. This prince held high views as to the

¹ "Sitzungsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin," 1891, xxvi. Sitzung der physikalisch-mathematischen Classe, vom 28 Mai. "Untersuchungen über die sogenannten leuchtenden Wolken," von O. Jesse, Steglitz.

powers of hereditary rulers. In his view the narrow liberties enjoyed by his subjects, under the Constitution reluctantly granted by William IV. in 1833, were excessive and intolerable. He suspended the Constitution, and thereby called forth vigorous protests from Dahlmann and other Professors of the Hanoverian University. As a punishment, seven of them—Dahlmann, Weber, the two Grimms (Jacob and Wilhelm), Albrecht, Gervinus, and Ewald—were ejected from their chairs, and Gervinus, Dahlmann, and Jacob Grimm were even expelled from the country. From this time Weber lived for some years in retirement, but in 1843 he accepted the Professorship of Physics in Leipzig (in succession to Fechner), and in 1849 he returned to his former position in the University of Göttingen. He was in Göttingen at the time of his death.

Wilhelm Weber's eldest brother, Ernst Heinrich, was the celebrated Professor of Anatomy and Physiology at Leipzig. He was born at Wittenberg in 1795, and died at Leipzig in 1878, having been elected a Foreign Member of the Royal Society of London in 1862. The youngest of the three brothers, Eduard Friedrich, was also highly distinguished as an anatomist, and held office for many years in the University of Leipzig.

Weber's first contribution to science at once took rank as a scientific classic, a position it is likely to keep for many years to come. This was "*Die Wellenlehre auf Experimente gegründet*," a volume of 574 pages, and 18 copper plates, nearly all engraved by the authors, published in 1825 by the brothers Ernst and Wilhelm Weber, and embodying the results of numberless original experiments and observations. One of the most striking results of these investigations was the discovery that, when a regular series of waves follow each other along the surface of water, the particles at the surface describe vertical circles whose plane is parallel to the direction of propagation of the waves, and those lower down ellipses of which the vertical axis becomes smaller and smaller with increasing depth. As to the composition of this work, the authors say that it grew up as the result of such constant and intimate communication between them with regard to all parts, that it is impossible to assign to either of them the separate authorship of any distinct portions.

For several years Weber continued to occupy himself mainly with questions of acoustics, on which he published various papers of importance. In 1833 he published, in conjunction with his brother, Eduard Friedrich, a memorable investigation into the mechanism of walking ("*Mechanik der menschlichen Gehwerkzeuge*").

But it is chiefly by his magnetic and electrical researches that Weber's place in the history of science is marked. These are contained for the most part in the "*Resultate aus den Beobachtungen des magnetischen Vereins*," published by Gauss and Weber from 1837 to 1843, and in Weber's "*Elektrodynamische Maassbestimmungen*" (published in collected form in 1864, though the first paper dates from 1846). In this series of papers Weber showed for the first time how methods of absolute measurement, analogous to those which Gauss had very shortly before shown to be applicable to magnetic measurements, could be extended into the region of electricity. Before this time Ampère's splendid discoveries as to the laws of the mutual forces between magnets and conductors traversed by electric currents, or between two such conductors, had been made known, and G. S. Ohm had established once for all the relations between electrical resistance, electromotive force, and strength of current; but, nevertheless, there was as yet no settled system for the measurement and statement of electrical quantities themselves. Until Weber's time electrical measurements were merely comparisons between magnitudes of the same kind: the resistance of one conductor could be compared with that of a particular piece of wire, the electromotive force of one

battery could be compared with that of another; but that the value of an electrical quantity could be stated without reference to any quantity of the same kind, and in terms not involving any physical constants but the units of length, time, and mass, was as yet an entirely new conception. Weber, however, not only showed that such a system of measurements was theoretically possible, but in a series of most masterly experimental investigations he showed how it could be practically carried out. Our countryman Sir William Thomson was one of the very first men of science to recognize the fundamental character and far-reaching importance of Weber's work; and owing mainly to his clear-sighted advocacy of the absolute system of measurement, this system was from the first adopted as the basis for the operations of the British Association Committee on Electrical Standards, appointed originally in 1862. This system has now become so familiar to electricians, and is taken so much as a matter of course, that it requires some mental effort to recall the state of science when it did not exist, and to appreciate the intellectual greatness of the man to whom it is due. If we consider method and point of view, rather than acquired results, it is not too much to say that the idea of absolute measurements, underlying as it does the conception of the conservation of energy, constitutes the most characteristic difference between modern physics and the physics of the early part of our century. And to no one man is so large a share in this great step due as to Wilhelm Eduard Weber.

Weber was a Corresponding Member of the Institute of France. He was elected a Foreign Member of the Royal Society in 1850. G. C. F.

A SOUVENIR OF FARADAY.

THE following letter, written by an old friend of Faraday's and of mine, long since dead, may interest your readers, now that we are celebrating the centenary of Faraday's birth. It came in reply to one in which I asked Mr. Ward's assistance in preparing an obituary notice of Faraday for the *Chemical News*.

WILLIAM CROOKES.

Cornwall, August 30, 1867.

DEAR CROOKES,—I should be proud indeed to be the spokesman of the chemical world in doing honour to Faraday's illustrious name on the occasion of his accession to immortality.

But I should not dare to meddle with the laurels on so august a brow, without many days and nights of earnest research and meditation, to fit me for summing up, without omission, the splendid list of his imperishable labours.

Only in this reverential spirit of earnest solicitude to do aright, which is, if I mistake not, the philosophical counterpart of prayer—of the religious feeling—could so solemn a duty be fitly undertaken.

Only with the aid of other minds, kindred with Faraday's in genius, and filled with the light of his manifold discoveries, could any one man's mind become an adequate mirror to reflect the gigantic Shadow that has just passed to its place in futurity.

For the present it is my fate to fulfil much humbler duties—which, having undertaken, I have no right to set aside. For duty must still be done, even when such appeals as yours set the wings of the caged lark trembling, and point him upwards to his barred out home.

I must remain, therefore, a unit among the millions whose hearts do silent homage to the illustrious dead; and can but watch from afar the starry coronation of which you invite me to be minister.

So best, perhaps. For, after all, the name and fame of